APPENDIX C

MEMBRANE-ENCAPULATED SOIL LAYERS (MESL)

C-1. Concept of encapsulation. Fine-grained soils exhibit high strength and low deformability (high stiffness) when well compacted at moisture contents below optimum. The membrane-encapsulated soil layer (MESL) is a developing technique to assure the permanence of these desirable properties by preserving the moisture content at its initial low level. Full-scale test sections have indicated excellent structural performance of a lean clay MESL serving as either base or subbase course in pavement systems in a warm climate. Experimental pavements undergoing tests in New Hampshire and Alaska also indicate that under favorable conditions MESL may serve as an acceptable replacement for granular material. Laboratory tests on fine-grained soils have shown that freezing under a closed system, i.e., preventing inflow of water from sources outside the moist soil specimen being tested, causes much less frost heave than freezing of similar specimens in the open system, i.e., with water fully available. Loss of supporting capacity during thaw also is much reduced in fine-grained soils that have been compacted at low moisture contents, because less moisture is available during freezing.

C-2. Testing requirements. If a MESL is proposed to be used in a pavement system in a frost area, any soil intended to be encapsulated should be thoroughly tested to determine classification index properties and CBR-moisture-density relationships. Representative samples should be tested to determine the effect of closed-system freezing on volume expansion, moisture migration, and reduction of resilient modulus, CBR, or other measure of supporting capacity, and to ascertain the moisture content at which the material must be placed to acceptably limit adverse frost effects. The results of the testing together with pavement design criteria in EM 1110-3-131 and EM 1110-3-141 will also serve to indicate at what levels in the layered pavement system the MESL may be used.

C-3. Materials.

a. Fine-grained soils. As guidance in the preliminary appraisal of the feasibility of MESL at a given location that experiences subfreezing temperatures, tests to date have shown that, among the fine-grained soils, soils of higher plasticity tend to respond most favorably to closed-system freezing. In general, it will be necessary to compact the soil on the dry side of optimum moisture content. Even nonplastic silts are substantially altered in their response to freezing by closed-system conditions, but tests to date indicate it will be necessary to place such soils at moisture contents several percentage points below the optimum values. The need for placement of encapsulated soil at low moisture contents establishes regional limits for the economical application of the MESL concept. Suitable soil

existing at a low moisture content must be available within economical haul distance, or the climate and rainfall regime must be such that reduction of moisture contents of the soil be economically feasible.

b. Membrane materials. From tests performed to date, it is considered that the most suitable membranes for use in cold regions are the same materials used in temperate climates. Successful experimental use has been made of a lower membrane of clear, 6-mil polyethylene, and an upper membrane of polypropylene cloth, field-treated with cationic emulsified asphalt conforming to ASTM D 2397, Grade CRS-2.

C-4. Construction practice. Construction techniques for encapsulation of soil have been developed in experimental projects. The recommended construction procedures have been summarized in a report for the Federal Highway Administration (Implementation Package 74-2). Special requirements for frost areas, not covered in the referenced report, relate to the rigorous control of moisture contents to meet the limiting values determined as outlined in paragraph C-2.